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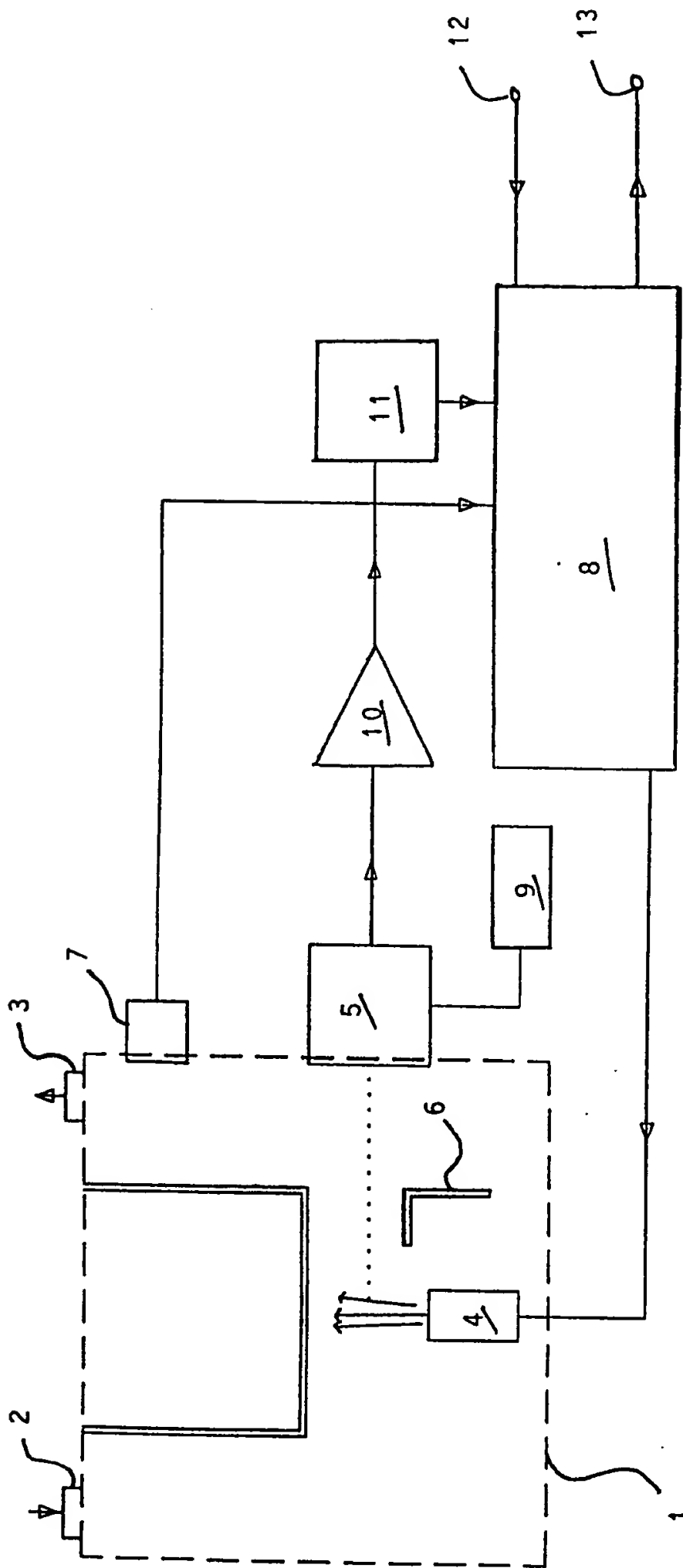
(56) Documents cited  
**EP 0476674 A US 4090392 A**

(58) Field of search  
**UK CL (Edition K) G1B BCE BCF**  
**INT CL<sup>5</sup> G01N**  
**Online databases: WPI; CLAIMS**

(54) **Detecting hazardous substances present in an area**

(57) An area monitoring system for detecting the presence of e.g. smoke or gases has a series of pipes having entry ports located in a plurality of positions in the area to be monitored and exit ports clustered together. The pipes are fabricated from an electrically insulating material and carry two or more electrical conductors embedded in or attached to them. Each pipe carries an electrically operated valve at its entrance. The exit port cluster is connected to at least one detector means and a controller adapted to draw air from the cluster and selectively detect the presence and source of any hazardous substances. The pipework is e.g. made from polyolefins. The pipes are fitted at their entrance with solenoid operated valves energised through the pipework conductors.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.



## HIGH INTEGRITY AREA MONITORING SYSTEM

This invention relates the monitoring of areas such as factories, large rooms and chemical plants in order to  
5 provide an early warning of the onset of dangerous conditions such as fire or the leakage of gases.

Individual sensors for the detection of heat, smoke, flames, gas, etc. are known. However when large areas are  
10 to be monitored large numbers of sensors are required to be located in different locations involving a complex network of wiring between the sensors and the central control and alarm system.

15 An alternative system for monitoring large areas uses a series of pipes with inlets distributed over the area. The pipes are gathered together at a central location where a suction fan or similar device draws air out of the pipes; the outlets from the pipes can be monitored by a single  
20 sensor or polled. The sensor in such a system may be of a much higher quality than in a multi-sensor system as only the cost of a single item is involved. A weakness of such a system is that the individual pipes and/or their intakes may become obstructed by foreign matter, cobwebs,  
25 condensation, etc so regular checks have to be made to ensure the integrity of each pipe.

The present invention provides a method of monitoring areas rapidly and at low cost with the minimum of electrical  
30 circuitry. Furthermore the method allows sections of the monitoring system to be individually switched to obtain higher resolution information. The method is capable of operation from a single low voltage and low current source such as a battery. Under such operating conditions the  
35 system may easily be designed to be intrinsically safe.

According to the present invention there is provided an area monitoring system for detecting the presence of airborne hazard indicating substances comprising a series of pipes having entry ports located in a plurality of positions in the area to be monitored and exit ports clustered together, characterised in that the pipes are fabricated from an electrically insulating material and carry two or more electrical conductors embedded in or attached to them, that each pipe carries an electrically operated valve at its entrance and in that the exit port cluster is connected to at least one detector means and a controller adapted to draw air from the cluster and selectively detect the presence and source of any hazard indicating substances.

The pipework is preferably made from materials such as polyolefins, e.g. polyethylene, polypropylene, polyallomers and mixtures, which are widely used for the manufacture of pipes by extrusion. Other materials which may be used include polyvinyl chloride and polyacetals. The conductors are preferably copper or a copper alloy, the conductors may be plated with tin, silver or other metals to reduce corrosion. Other conductors such as aluminium may be used. Such pipes are described in GB-A-2 217 425.

The pipes are fitted with solenoid operated valves which may be energised through the pipework conductors. The current can be reduced to a low level by means of the capacitor storage method described in GB-A-1 466 246. Using this method the current consumption is extremely low since the current is mainly utilised to charge capacitors which provide the necessary energy to operate the valve when required. Such an arrangement enables intrinsically safe systems to be greatly simplified. Such safety is often required in the areas where the monitoring system may be installed.

In general two conductors are required on the insulating pipe to carry current at a low potential, e.g. five volts dc. Using the above described capacitor storage system enough energy is provided for producing the short impulses  
5 necessary for switching the valves.

A further alternating current or digital signal may be superposed on the direct current for control purposes. Thus a central controller can supply signals to any of the  
10 valves and close or open them as required.

In many applications a simpler system may be used in which the valves are opened and closed successively at regular intervals, e.g. five seconds. Such a polling system would  
15 enable a single detector and controller to indicate not only the presence of an atmospheric hazard but also from which pipe it originated. In the event of a fault on a pipe the relevant valve can be closed excluding the pipe from the system.

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The detection means is selected according to the type of atmospheric hazard being monitored. In the case of solvent vapours or gases the detector may be a gas chromatograph whereas in the case of smoke or dust  
25 particles a change in absorption or scattering may be detected using optical means or the absorption of beta radiation.

When fine particles are to be detected such as smoke and  
30 dust scattering of a light beam by the Tyndall effect may be used. The air containing particles is illuminated by a beam of light originating from a laser, tungsten filament or light emitting diode. A detector, preferably a photo-multiplier cell is arranged to receive only scattered  
35 light. In order to improve sensitivity the light source

is preferably modulated so that the detected signals may be selectively amplified as alternating current signals.

In certain applications, such as the storage of inflammable substances, two or more detector means may be located successively. For instance a first detector means using gas chromatography, infra-red absorption or a fuel cell type detector may be used to detect leakage. This can be followed by a beta radiation absorption or an optical sensing system to detect smoke.

In order that the invention may be clearly understood one embodiment will now be described with reference to the accompanying drawing in which the single figure is a schematic layout of a monitoring system according to the invention.

The system comprises a chamber 1 having an air ingress and exit ports 2 and 3 respectively. The chamber 1 contains a light source 4 and photosensitive detection means 5 oriented at  $90^{\circ}$  to the light source 4. An opaque baffle having low reflectance 6 is located in the chamber 1 in a manner which ensures that no direct light from the source 4 falls on the detection means 5. A flow sensor 7 provides an electrical signal proportional to the volume of air passing through the chamber 1. The flow of air may be assisted by a fan, not shown, located on or downstream from the exit port 3.

The light source 4 is modulated, preferably electrically, by signals from a controller 8. The detection means 5 is preferably a photomultiplier cell and is supplied with a stabilised source of high voltage 9. The signals from the detection means 5 are fed to an amplifier 10 having operating characteristics which are selective for any

signals modulated at the same frequency as the light source and which allow a threshold sensitivity to be set. The output of the amplifier 10 is fed to a counter 11 whose output passes to the controller 8. The controller also has  
5 an input 12 for electrical power and for the output of the sensor 7. The controller has an annunciator output 13 for providing warning or alarm signals to annunciator means, not shown, such as a buzzer.

10 The light source 4 is supplied with an alternating or pulsating electrical supply from the controller so that its output is modulated. When air entering the chamber 1 from the port 2 contains fine particles light from the source 4 will be scattered at right angles. The scattered light is  
15 detected by the detection means 5 and an electrical signal fed to the amplifier 10. As the light originating from the source 4 is modulated, the signals received by the amplifier 10 having this particular frequency will be selectively amplified if they exceed the preset threshold  
20 limit.

The output of the amplifier 10 passes to the counter 11, where the output is recorded, and to the controller 8. The controller 8 also receives signals from the flow sensor  
25 7. This enables the amount of detected light and the flow rate to be used to calculate the concentration of smoke at the source. The controller 8 can also supply control signals to the various valves at the pipe entrances. When smoke is detected selective closing of the valves allows to  
30 the location or locations in the area where smoke exists to be determined.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be  
35 understood that variations and modifications can be effected within the spirit and scope of the invention.

## CLAIMS

1. An area monitoring system for detecting the presence of airborne hazard indicating substances comprising a  
5 series of pipes having entry ports located in a plurality of positions in the area to be monitored and exit ports clustered together, characterised in that the pipes are fabricated from an electrically insulating material and carry two or more electrical conductors embedded in or  
10 attached to them, that each pipe carries an electrically operated valve at its entrance and in that the exit port cluster is connected to at least one detector means and a controller adapted to draw air from the cluster and selectively detect the presence and source of any hazard  
15 indicating substances.
2. An area monitoring system according to claim 1, characterised in that the electrically insulating material is a polyolefin or polyvinyl chloride.  
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3. An area monitoring system according to claims 1 or 2, characterised in that the electrical conductors are copper, a copper alloy or aluminium.
- 25 4. An area monitoring system according to claims 3, characterised in that the electrical conductors are plated to reduce corrosion.
5. An area monitoring system according to any of the  
30 preceding claims, characterised in that the electrically operated valve is a solenoid valve.
6. An area monitoring system according to claim 5, characterised in that the electrically operated valve has  
35 an associated charge storage capacitor.

7. An area monitoring system according to any of the characterised in that the presence of any hazard indicating substance is detected optically.
- 5 8. An area monitoring system according to claim 7, characterised in that the presence of any hazard indicating substance is detected by the scattering of a light beam by the Tyndall effect.
- 10 9. An area monitoring system according to claim 8, characterised in that the light beam is modulated.
10. An area monitoring system according to claims 8 or 9, characterised in that the light beam is generated by a  
15 laser or light emitting diode.
11. An area monitoring system according to any of the claims 7 to 10, characterised in that the scattered light is detected by means of a photomultiplier cell.  
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12. An area monitoring system according to any of the claims 7 to 11, characterised in that the light beam generator and scattered light detector are housed in a chamber with air ingress and exit ports.  
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13. An area monitoring system according to claim 12, characterised in that the chamber includes a flow sensor which provides a signal proportional to the volume of air passing through it.  
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14. Area monitoring systems according to claim 1 and as herein described.
15. Area monitoring systems as herein particularly  
35 described with reference to, and as shown in, the accompanying drawings.

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**Patents Act 1977**  
**Examiner's report to the Comptroller under**  
**Section 17 (The Search Report)**

Application number

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**Relevant Technical fields**

(i) UK CI (Edition L) G1B (BCE, BCF)

(ii) Int CI (Edition 5) G01N

**Search Examiner**

M R WENDT

**Databases (see over)**

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI, CLAIMS

**Date of Search**

23 NOVEMBER 1992

Documents considered relevant following a search in respect of claims

1-15

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A, E	EP 0476674 A (SPACE BIO) - see whole document	1, 2
A	US 4090392 (ETHYL) - see whole document	1, 2, 7

SF2(p)

lms - doc99\fil000355



Category	Identity of document and relevant passages	Relevant to claim(s).

### Categories of documents

**X:** Document indicating lack of novelty or of inventive step.

**Y:** Document indicating lack of inventive step if combined with one or more other documents of the same category.

**A:** Document indicating technological background and/or state of the art.

**P:** Document published on or after the declared priority date but before the filing date of the present application.

**E:** Patent document published on or after, but with priority date earlier than, the filing date of the present application.

**&:** Member of the same patent family, corresponding document.

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